

Claims

1. A nitride based 3-5 group compound semiconductor light emitting device comprising:

5 a substrate;
a buffer layer formed above the substrate;
a first In-doped GaN layer formed above the buffer layer;
an $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ super lattice structure layer
10 formed above the first In-doped GaN layer;
a first electrode contact layer formed above the $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{In}_y\text{Ga}_{1-y}\text{N}$ super lattice structure layer;
an active layer formed above the first electrode contact layer and functioning to emit light;
15 a second In-doped GaN layer;
a GaN layer formed above the second In-doped GaN layer;
and
a second electrode contact layer formed above the GaN layer.

20 2. The device according to claim 1, wherein the second electrode contact layer is an n-type electrode contact layer.

25 3. The device according to claim 1, wherein the buffer layer comprises one selected from the group consisting of an InGaN/GaN super lattice structure, an $\text{In}_x\text{Ga}_{1-x}\text{N}/\text{GaN}$ structure and an $\text{Al}_x\text{In}_y\text{Ga}_{1-x,y}\text{N}/\text{In}_x\text{Ga}_{1-x}\text{N}/\text{GaN}$ structure.

30 4. The device according to claim 1, wherein the first electrode contact layer comprises a Si/In-codoped GaN layer.

5. The device according to claim 1, wherein the active layer comprises a single or multiple quantum well structure.

35 6. The device according to claim 1, wherein the active layer comprises a single or multiple quantum well structure, including a low mole In-doped $\text{In}_x\text{Ga}_{1-x}\text{N}$ layer, an $\text{In}_y\text{Ga}_{1-y}\text{N}$

well layer and an $In_zGa_{1-z}N$ barrier layer.

7. The device according to claim 6, wherein the low mole In-doped $In_xGa_{1-x}N$ layer has an In content smaller than
5 that of the $In_zGa_{1-z}N$ barrier layer.

8. The device according to claim 6, wherein the low mole In-doped $In_xGa_{1-x}N$ layer, the $In_yGa_{1-y}N$ well layer and the $In_zGa_{1-z}N$ barrier layer have an In content expressed as $0 < x < 0.05$, $0 < y < 0.3$ and $0 < z < 0.1$, respectively.
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9. The device according to claim 6, wherein the low mole In-doped $In_xGa_{1-x}N$ layer has a surface configuration that is grown in a spiral mode.
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10. The device according to claim 6, wherein the low mole In-doped $In_xGa_{1-x}N$ layer has a surface configuration that is grown in a spiral mode, and wherein the spiral mode is extended to the surface of the $In_zGa_{1-z}N$ barrier layer.
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11. The device according to claim 1, wherein the second electrode contact layer comprises an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure.
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12. The device according to claim 1, wherein the low mole In-doped $In_xGa_{1-x}N$ layer and the $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer formed thereon are repeatedly layered in plurality.
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13. A nitride based 3-5 group compound semiconductor light emitting device comprising:
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a substrate;

a buffer layer formed above the substrate;

a first In-doped GaN layer formed above the buffer layer;
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a first electrode contact layer formed above the first In-doped GaN layer;

an active layer formed above the first electrode contact layer and functioning to emit light;

a GaN layer formed above the active layer; and

a second electrode contact layer formed above the GaN

5 layer.

14. The device according to claim 13, wherein the second electrode contact layer is an n-type electrode contact layer.

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15. The device according to claim 13, further comprising a second In-doped GaN layer formed between the active layer and the p-type GaN layer.

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16. The device according to claim 13, further comprising an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer formed between the first In-doped GaN layer and the first electrode contact layer.

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17. The device according to claim 13, further comprising an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure and an undoped GaN layer between the first In-doped GaN layer and the first electrode contact layer.

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18. The device according to claim 13, wherein the buffer layer comprises one selected from the group consisting of an InGaN/GaN super lattice structure, $In_xGa_{1-x}N/GaN$ structure and an $Al_xIn_yGa_{1-x,y}N/In_xGa_{1-x}N/GaN$ structure.

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19. The device according to claim 13, wherein the first electrode contact layer comprises a Si/In-codoped GaN layer.

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20. The device according to claim 13, wherein the active layer comprises a single or multiple quantum well structure.

21. The device according to claim 13, wherein the active layer comprises a single or multiple quantum well structure, including a low mole In-doped $In_xGa_{1-x}N$ layer, an $In_yGa_{1-y}N$ well layer and an $In_zGa_{1-z}N$ barrier layer.

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22. The device according to claim 21, wherein the low mole In-doped $In_xGa_{1-x}N$ layer has an In content smaller than that of the $In_zGa_{1-z}N$ barrier layer.

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23. The device according to claim 21, wherein the low mole In-doped $In_xGa_{1-x}N$ layer, the $In_yGa_{1-y}N$ well layer and the $In_zGa_{1-z}N$ barrier layer have an In content expressed as $0 < x < 0.05$, $0 < y < 0.3$ and $0 < z < 0.1$, respectively.

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24. The device according to claim 21, wherein the low mole In-doped $In_xGa_{1-x}N$ layer has a surface configuration that is grown in a spiral mode.

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25. The device according to claim 21, wherein the low mole In-doped $In_xGa_{1-x}N$ layer has a surface configuration that is grown in a spiral mode, and wherein the spiral mode is extended to the surface of the $In_zGa_{1-z}N$ barrier layer.

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26. The device according to claim 13, wherein the second electrode contact layer comprises an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure.

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27. A fabrication method of a nitride based 3-5 group compound semiconductor light emitting device, comprising:

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forming a buffer layer above a substrate;
forming a first In-doped GaN layer above the buffer layer;
forming a first electrode contact layer above the first In-doped GaN layer;
forming an active layer for emitting light above the first electrode contact layer;

forming a GaN layer above the active layer; and forming a second electrode contact layer above the GaN layer.

5 28. The fabrication method according to claim 27, wherein the second electrode contact layer is an n-type electrode contact layer.

10 29. The fabrication method according to claim 27, wherein the first electrode contact layer comprises a Si/In-codoped GaN layer.

15 30. The fabrication method according to claim 27, wherein the second electrode contact layer comprises an $In_xGa_{1-x}N/In_yGa_{1-y}N$ super lattice structure layer.

20 31. The fabrication method according to claim 27, wherein the active layer comprises a single or multiple quantum well structure, including a low mole In-doped $In_xGa_{1-x}N$ layer, an $In_yGa_{1-y}N$ well layer and an $In_zGa_{1-z}N$ barrier layer.

25 32. The fabrication method according to claim 31, wherein the low mole In-doped $In_xGa_{1-x}N$ layer is grown to have a surface configuration in a spiral mode.

30 33. The fabrication method according to claim 31, wherein the low mole In-doped $In_xGa_{1-x}N$ layer is grown into a surface configuration of a spiral mode, wherein the spiral mode is extended to the surface of the $In_zGa_{1-z}N$ barrier layer.

35 34. A nitride based 3-5 group compound semiconductor light emitting device comprising:

- a substrate;
- a buffer layer formed above the substrate;
- a first electrode contact layer formed above the GaN

buffer layer;
an active layer formed above the first electrode contact layer, and including a low mole In-doped $In_xGa_{1-x}N$ layer, an $In_yGa_{1-y}N$ well layer and an $In_zGa_{1-z}N$ barrier layer;
5 a GaN layer formed above the active layer; and
a second electrode contact layer formed above the GaN layer.

10 35. The device according to claim 34, wherein the second electrode contact layer is an n-type electrode contact layer.

15 36. The device according to claim 34, wherein the low mole In-doped $In_xGa_{1-x}N$ layer has an In content smaller than that of the $In_zGa_{1-z}N$ barrier layer.

20 37. The device according to claim 34, wherein the low mole In-doped $In_xGa_{1-x}N$ layer, the $In_yGa_{1-y}N$ well layer and the $In_zGa_{1-z}N$ barrier layer have an In content expressed as $0 < x < 0.05$, $0 < y < 0.3$ and $0 < z < 0.1$, respectively.

25 38. The device according to claim 34, wherein the low mole In-doped $In_xGa_{1-x}N$ layer has a surface configuration that is grown in a spiral mode.

39. The device according to claim 34, wherein the low mole In-doped $In_xGa_{1-x}N$ layer has a surface configuration that is grown in a spiral mode, wherein the spiral mode is extended to the surface of the $In_zGa_{1-z}N$ barrier layer.